Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 159 (2016) 210 – 216

Procedia Engineering

www.elsevier.com/locate/procedia

Humanitarian Technology: Science, Systems and Global Impact 2016, HumTech2016, 7-9 June 2016, Massachusetts, USA

Knowing Just in Time: Use cases for mobile surveys in the humanitarian world

Nathan Morrow[a], Nancy Mock[a], Jean-Martin Bauer[b,*], Jennifer Browning[b]

[a]*Tulane University, Payson Graduate Program in Global Development, 6823 St. Charles Avenue, NewOrleans, LA 70118, United States*
[b]*World Food Programme, Via Cesare Giulio Viola 68/70, 00148 Rome, Italy*

Abstract

Mobile surveys have the potential to enhance food security information systems that have struggled to provide effective decision support. The mobile Vulnerability Analysis and Mapping (mVAM) project at the World Food Programme uses mobile technologies to collect food security information remotely. This paper documents use cases for mVAM (in camps, conflict, and vulnerable geographies) and assesses the tool's contribution to decision-making. Managers have used mVAM to support advocacy and prioritize resources, but important obstacles remain before mobile surveys can transform information systems. mVAM and related initiatives should continue to build a rigorous evidence base and embrace open models of innovation.

Peer-review under responsibility of the Organizing Committee of HumTech2016

Keywords: food security; information systems; mobile technologies; food assistance; monitoring

1. Introduction

Much has been written about the failure of food security and nutrition information systems for pre-empting and managing food and nutrition security related emergencies [1-4]. The reasons that food security and nutrition information systems have failed to deliver decision-support for triggering and managing interventions are numerous; they include: the timeliness, validity and usability of the information as well as high data collection costs and feasibility constraints. Delayed response to events such as the 2008 food price crisis may also be attributed to on-going difficulties and broad disagreement about the most appropriate measures as well as the behavior of common indicators used to characterize the somewhat elusive concept of food and nutrition security [5]. Other authors have pointed to structural constraints for relief agencies to incorporate new information such as real time monitoring or higher frequency assessments into their programming and even more difficulty in making use of that data to influence decision making in the often laborious political negotiations on the type and scope of relief among donors, affected countries, and relief organizations [6-8]. Furthermore, physical constraints, i.e. the fact that the most vulnerable populations often live in remote places poorly connected by infrastructure or in conflict zones, make data collection extremely costly, time-consuming, and in some cases, dangerous.

The dramatic expansion globally of cell phone coverage and other new information streams ushered in an era of new opportunities to reach out to crisis affected populations, capturing close to real time information about their food security status and its determinants as well as providing a channel of communications between affected communities, (potential) beneficiaries and humanitarian actors. WFP's mobile Vulnerability Analysis and Mapping (mVAM) project is one such initiative. Since 2013, mVAM has been collecting data, leveraging cell phone technologies and the emerging information ecosystem around them by SMS, live telephone calls and an Interactive Voice Response (IVR) system. WFP implemented high frequency monitoring (multiple observations across time) of food insecurity in crisis affected countries. Short surveys aimed at monitoring food

* Corresponding author. Tel.: +39-06-6513-3821; fax: +39-6513-2817.
E-mail address: jean-martin.bauer@wfp.org

Peer-review under responsibility of the Organizing Committee of HumTech2016
doi:10.1016/j.proeng.2016.08.163

insecurity and its immediate causes were conducted in 12 crisis affected countries, representing more than 100,000 surveys [9]. While other organizations are using similar approaches in low income stable contexts, WFP is both in the vanguard of the operational use of high frequency information to improve the humanitarian response and has an unequaled scale and diversity of applications in many of the most demanding contexts. It is worth noting that mVAM has involved a variety of technological tools, from free and open source software to commercial vendors, and has not relied on a single platform. It is not in this paper's scope to address the comparative advantage of one or the other tool, but rather to reflect on the technology's effects on humanitarian information systems.

The mVAM experience - which has covered various geographies, types of crisis (Ebola, conflict, drought), and survey modes (SMS, IVR, voice calls) - offers the opportunity to assess whether new, technology-enabled data streams live up to the hype. This paper investigates the nature of data collected by mobile surveys and improvements over existing food security information systems. The authors make use of selected case studies and survey results from WFP humanitarian relief managers in Country Offices that have implemented mVAM data collection to examine whether new capabilities for data collection have actually influenced or improved decision making. Finally, the authors discuss barriers to uptake of high frequency mobile data collection and the potential next steps in development of this capability.

This paper focuses specifically on how the mVAM approach has the potential to address some of the recurring challenges to Food and Nutrition Security monitoring namely:

Monitoring is expensive and therefore unsustainable.

Monitoring focuses on areas where information is available. This is akin to looking for keys under the street light and thus leaves the most marginalized and vulnerable communities in the shadows where information is typically least available.

Indicators are collected too infrequently to capture changes.

Sampling techniques in monitoring systems are unable to adequately represent dynamic and unstable populations.

2. Background -- a variety of mVAM deployments in Africa and the Middle East

In 2013 with support of the Humanitarian Innovation Fund, mVAM launched a series of localized pilots involving voice calls that targeted IDP communities in the Democratic Republic of Congo and Somalia [ ]. These pilots were designed as proof of concept exercises with face-to-face surveys as a baseline comparison for data that would be collected by mobile phones. These pilots soon attracted the attention of private sector partners to lend technical and financial support to mVAM activities as well as created demand for mVAM products by local relief operation managers [ ]. This early success with capturing useful information from difficult to reach populations was recognized by senior management at WFP and was called into service as the Ebola crisis spread in West Africa. With restricted access to affected populations and limited information about the humanitarian situation, mVAM used SMS to track food security conditions in Guinea, Sierra Leone and Liberia during and after the Ebola epidemic. As a unique source of situational awareness in a virtual information vacuum, a growing number of partners including the Joint Research Center, FEWS NET, and the International Growth Center began to use mVAM data in their situation reports [12].

mVAM has since expanded in sub-Saharan Africa (Kenya, Somalia, Niger, Chad, Malawi) and to the Middle East (Iraq and Yemen), amounting to 12 individual deployments of mVAM survey approaches. Thus far, mVAM has been deployed in the following contexts: 1) refugee or IDP camps where food security conditions are dependent on factors largely out of the control of displaced people and where populations are or may become mobile, 2) conflict or emergency situations where mobile data collection is the only available option for insecure or inaccessible areas, and 3) chronically vulnerable geographies such as drought prone areas that require on-going monitoring where populations are constantly near a tipping point for large scale food insecurity. Regular assessment with traditional surveys is often too expensive to implement until after a crisis is well underway. The potential, and a projected focus area for future mVAM deployments, is to use lower cost, higher frequency monitoring to promote early action in these vulnerable geographies.

An mVAM deployment consists of mobile survey equipment, software, and training to conduct short surveys by SMS, IVR and/or voice calls. mVAM surveys generally take place on a monthly basis and include the WFP corporately mandated indicators of Food Consumption Scores (FCS) and the reduced Coping Strategy Index (rCSI) [13,14]. Price data, open-ended questions, and key informant interviews have also been included based on management requests.

2.1. Context 1: Refugee and IDP Camps

In camps, insecurity and remoteness can restrict access by humanitarian organizations. Arrivals of newly displaced people and the return of formerly displaced populations create a population dynamic that can be a challenge for traditional survey methodologies to capture. Changes in security, economic conditions, and assistance levels can interact to affect household food security in unpredictable ways, and statistics can rapidly become out of date. The deployment of mVAM allowed WFP to track food security with respect to changes in assistance levels (DRC, Niger, Chad, Sudan) and closely monitor food markets as cash transfers were initiated (Dadaab and Kakuma in Kenya). In most cases, WFP implemented the activity in-house, as camps are a 'confined' area where it is possible to conduct face-to-face baselines that enable validation of data collected by phone. In Sudan, by analyzing face-to-face and mobile data, WFP learned that some better-off respondent households attempted to 'game' the calls by underreporting their consumption of high quality foods. WFP learned that engagement through community-based NGOs

greatly enhanced engagement and response to the survey and that protection concerns should be prioritized in such contexts [15]. The implementation of mVAM in camps settings is perhaps the most easily replicable case.

2.2. Context 2: Conflict or emergency situations

Information is at a premium at the early stages of an emergency, especially from hard to reach areas. The fairly short set-up times mean that mVAM is suited to providing updates to field managers, in spite of insecurity and barriers to accessing vulnerable populations. For Ebola, mVAM set up an SMS survey in a matter of weeks, allowing the production of data in spite of widespread quarantines and restrictions on the movement of humanitarian staff. At US$5-6 per SMS questionnaire, data collection costs were 50% cheaper than face-to-face interviews [16]. In Yemen, mVAM consistently reached respondents in all parts of the country through voice calls placed from a third country [17]. Likewise mVAM reached carefully-screened key informants in parts of Iraq held by armed opposition groups, providing unique insight into food security conditions that would otherwise not have been obtained. mVAM was essentially the only source of household food security data during the first months of these emergencies; this ability to shed light on food security conditions in what have been 'no go areas' is an essential advantage of remote surveys. The limitations observed in this context include the functioning of the mobile network in conflict zones where towers may be switched off or destroyed and the potential of risk to respondents. Voice calls that do not leave a text trail are used out of concern for respondents' security. Also, since no baseline is available to ensure data quality unlike in camp-based settings, there is less certainty about bias.

2.3. Context 3: Vulnerable geographies and slow onset disasters

Increasingly, mVAM is deploying in countries exposed to slow onset hazards, such as drought. While the same security concerns are not present as in the first two contexts, the geographies can be vast with poor infrastructure, making traditional data collection time-consuming and expensive. Early warning systems are often resource-poor, and there is hope that mobile data collection could be an affordable way to monitor household food security. In the case of Malawi, mVAM was able to implement nationwide SMS surveys in 24 hours, an unprecedented speed, and at low cost. The approach was also deployed in Papua New Guinea, where exceptionally rugged terrain made face-to-face data collection impossible within a short timeframe. In these vulnerable geographies, cell phone ownership rates are often low (30-40%) with strong bias to young, urban, male respondents. As the data is not representative, WFP attempts to profile respondents by wealth and focus on changes in food security status over time, rather than estimating food insecurity levels.

3. Results of mVAM deployments and illustrative 'use cases'

In order to understand the value of mVAM for decision support, we reached out to WFP field managers who work in operations where the tool was deployed. We received 11 responses, a number that is probably sufficient to roughly outline how the tool is perceived to have supported decision making in the 12 deployments to date. We also rely on personal interviews with field managers and communities [18].

3.1. Support to a broad set of applications including advocacy and resource allocation

Most managers use mVAM data to support their advocacy. mVAM information is routinely mentioned in the operational briefs that country offices share with their internal and external stakeholders [19]. mVAM data has also supported country-level humanitarian appeals, including the US$500 million in the 2015 Interagency Humanitarian Response Plan in Iraq [20]. mVAM data has been used to 'develop media messages' for the public at-large and has figured in WFP press releases for Ebola, Yemen, and Iraq.

Half of managers mentioned that they use information to 'fine tune' interventions and 'prioritize' resources on the basis of the 'a bird's eye view of the [relief] operation' that mVAM provides. Mock et al. [21] show that early use cases of mVAM data demonstrated a broad set of operational applications even in consideration of the relatively modest number of indicators and the scope of the pilot. The first use of the mVAM data by the Goma- Democratic Republic of Congo Area Office was to compare beneficiary and non-beneficiary food consumption. WFP Country Office staff also used mVAM monitoring to show the "impact of WFP's ration and overall vulnerability situation" following a distribution to the IDP camp. Later, mVAM analysis was used in an "extrapolation" to other camps, including those from another displacement event and outside Goma [22]. The potential for similar food insecurity in in other camps due to seasonal and market issues was a trigger for a new round of face-to-face surveys. In general, WFP staff interviewed in DRC were extremely supportive of the high frequency monitoring and creative in its application to programme decisions.

Perhaps the most promising use of mVAM data took place in the analysis of prices, wages, food consumption and coping levels of those affected by the Ebola crisis. mVAM deployed quickly; data collection through SMS and IVR was up and running (and reporting) in about a month in three countries. mVAM data showed that food insecurity was deteriorating in rural areas that had a comparatively low number of Ebola cases compared to urban centers. Restricted access to markets and job opportunities

affected the food security of many rural households outside the high Ebola caseload areas receiving the most attention. mVAM data also showed that food prices had not spiked to the extent initially reported in the press [23]. This informed the strategy for food assistance during the response, including the use of cash-based transfers.

mVAM also helped WFP respond to acute food needs in conflict settings such as Iraq where mVAM started operating in February 2015. The data provided evidence of extremely high food prices in the besieged city of Haditha, located in conflict-affected Anbar governorate. Cornish [24] reports that WFP was able to use this information to reach the city and provided enough food to feed 15,000 people for a month.

3.2. Open data accessed and used by a variety of partners

In order to make data available as a public good, aggregate mVAM results are made available on WFP's public website on an open-access basis, including in machine-readable form. There is evidence of the use of mVAM data by many external parties including Governments, FEWS NET, other UN agencies, the European Commission, and NGOs. The data has been shared with UNOCHA's Humanitarian Data Exchange. Reports by FEWS NET on Ebola and Yemen make extensive reference to mVAM findings [25].

The Joint Research Center funded by the European Union conducted a detailed study of the food security effects of the Ebola crisis and referred frequently to the mVAM monitoring data [26]. The International Growth Center that conducts research to inform development policy also used mVAM price and wage data in their analysis of the longer-term effects of the Ebola crisis [27]. This demonstrates the potential of mVAM to feed into decision making processes for actors other than WFP.

mVAM data has also been used to feed into interagency decision making processes. mVAM was one of the few sources of household food security information used for the cadre harmonisé round for Ebola affected countries that took place in early 2015 [28]. This 'fresh' primary data helped the West Africa food security community better assess the food security impacts of the crisis.

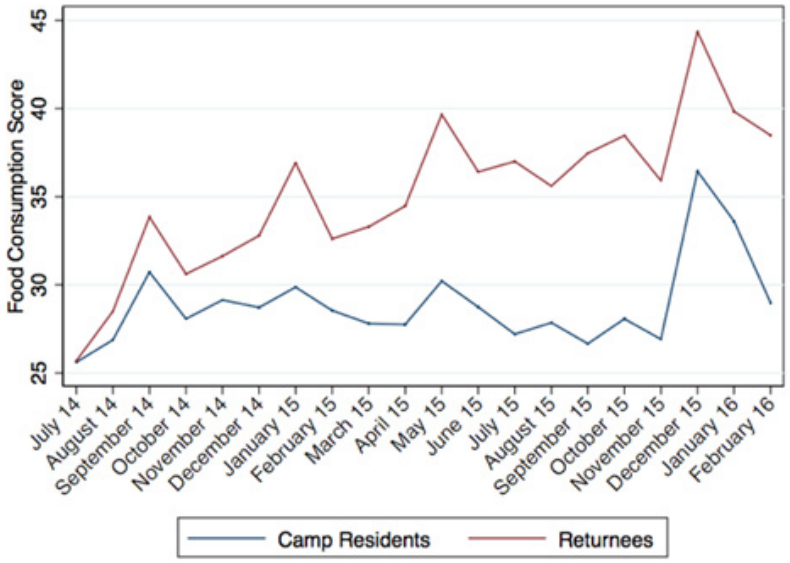

Fig. 1. IDP Food Consumption Score Comparison in DRC: Camp Residents vs. Returnees.

3.3. Potential new approaches for food security analysis/decision making

Mobile data collection has also allowed for continuous high frequency food security tracking that helps document a community's food security trajectory. In DRC in 2014, WFP provided mobile phones to 400 residents of Mugunga 3 camp, yielding response rates that fluctuated between 60-75% throughout the 24 monthly data collection rounds that have since been implemented. Interestingly, people who received phones at the start of the survey rounds continued participating in the survey even after they left the camp to return home or move elsewhere, allowing comparisons of trends for camp residents and returnees. In Figure 1, Pasquier [29] compares food consumption of returnee households who start to leave the camp in March 2015 with households that remain in the camp throughout the 24 months of the survey. Pasquier shows that returnees' food consumption indicators improve month to month, while food consumption of households still in the camp remains consistently poor with the exception of a spike for both groups in December 2015. Pasquier estimates a 27% increase in household's food

consumption score when leaving the camp. Such analysis would be impossible without the ability to collect data every month for 2 years and to keep reaching respondents after they leave a camp. This new data has not yet been used to inform policy at WFP, perhaps because of its novel nature, but could clearly support efforts to support returnees.

Interestingly, two managers we interviewed mentioned 'feedback' to communities as an application of mVAM, which suggests that communication with communities represents a learning area to be further explored. There is generally a high level of interest in using the tool in areas other than early warning and monitoring.

3.4. Barriers to mVAM

Remote data collection has, at times, encountered constraints, owing either to incomplete cell phone coverage or to the impact of conflict on the functionality of cell phone networks. Although the cell phone network is expanding quickly in the Democratic Republic of Congo - by 1,000 new base stations a year in DRC - many areas are not covered and therefore out of reach of mobile data collection. In Iraq, active conflict greatly limited WFP's ability to reach households in the conflict-affected Anbar governorate in December 2015 and January 2016 when sample quotas were not met; however WFP was able to continue reaching key informants in the province at the time [30].

Disparities in mobile phone ownership can present another barrier as highly vulnerable groups may not own cell phones in many settings. While it is possible to track the food security of such groups, the data is not representative. One option could be to provide devices to poor households. However, as Mock et al. [31] show, doing so could imply significant risks to people in conflict settings.

Some managers were unsatisfied by the quality of the analysis of mVAM data, which suggests that some offices are struggling to leverage the data that is collected. High frequency data collection at scale implies robust capacities to store and process the large volumes of information produced. While barriers to entry for data collection have vanished thanks to free and open source tools, they have to some extent been supplanted by barriers to analyzing information. A related challenge remains the occasional skepticism expressed by some analysts, an attitude that calls for continued transparency and validation of the data that is collected. In such cases, while a data gap may have been covered, a knowledge gap remains.

4. Conclusion: from high-frequency monitoring to decision support

The data revolution promises to deliver ever more granular and frequent information to field managers, including in low-access contexts. mVAM's experience has shown that such data helps managers understand what is going on at a high level -- providing a 'bird's eye view' for responders in geographies affected by conflict, displacement and drought. While the immediate use of the data has been to support advocacy, use cases show that high frequency monitoring has also informed operational decisions in some cases.

However, use cases also show that some WFP offices are not equipped to fully reap the benefits of high frequency monitoring. In particular, resource-poor organizations and field offices are likely to struggle to collect and analyze the data, leaving decision-makers back at square one. The important barriers to analyzing and making use of the data also raise the possibility of 'natural monopolies' emerging in the field of mobile data collection. A single agency or group of agencies could find itself as the dominant broker of monitoring information, with its findings dominating analysis of the food security situation. Under that scenario, mobile data collection would only perpetuate the top-down, centralized and donor-driven early warning model described in Mock et al. [32].

There remains additional scope to 'democratize' and embrace open innovation, with the ultimate goal of enabling partners and communities to understand and embrace the method and results that are produced. With a promising proof of concept demonstrated in documented use cases, WFP appears to be well positioned to lead learning and further development of high frequency mobile data collection particularly in complex contexts where there has previously been little success in promoting use or sustaining monitoring data.

Further research is required to better understand the dynamics of mobile data collection, particularly with displaced and mobile populations. It is a priority to test the performance of nutrition indicators within mVAM. Immediate research could focus on assessing how self-reported dietary diversity indicators perform by voice and SMS. Testing a nutrition proxy constitutes a promising avenue for research, because of the high value that nutrition data has for decision markers. In analyzing open-ended questions, mVAM uses word clouds that display the most frequently used terms to visualize respondent descriptions of their community's food security situation as in Figure 2 from a household survey in Malawi. To provide additional rigor, mVAM recently experimented with pattern sentiment analysis and natural language processing algorithms of open-ended responses, which have helped deliver insights into causality. Further research is needed to test the different tools that exist in order to identify the ones that perform with the highest degrees of accuracy in multiple languages.

Technical aspects such as mode effects, operator effects, and the other potential types of respondent bias have some preliminary evidence but remain unresolved. Knowing that confidence in quality of information is a prime determinant of use, next steps include building a rigorous evidence base and program of learning to realize the potential broader benefits of mVAM and other mobile survey initiatives.

Fig. 2. Word Cloud from open-ended question to households in Malawi

References

[1] Walker, P, Famine early warning systems: victims and destitution, Earthscan, London, 1989.
[2] Devereux, S. and S. Maxwell, Food security information systems, in: Food security in sub-Saharan Africa (2001): 201-230.
[3] McCalla, A., N. Mock, Report of the External Assessment and Strategic Planning Exercise (EASP) for the Interagency Working Group, Food Insecurity and Vulnerability Information and Mapping Systems, FAO, Rome, 2004.
[4] Mock, N., N. Morrow, A. Papendieck, From complexity to food security decision-support: Novel methods of assessment and their role in enhancing the timeliness and relevance of food and nutrition security information. Global Food Security, 2.1, 41-49, 2013.
[5] Barrett, C.B, Measuring food insecurity, Science, 327.5967 (2010) 825-828.
[6] Buchanan Smith, M., S. Davies, Famine early warning and response: the missing link, Intermediate Technology Publications, 1995.
[7] Darcy, J., C. Hofmann, According to need? Needs assessment and decision-making in the humanitarian sector, 2003.
[8] Morrow, N., et al, Independent evaluation of the ushahidi Haiti project, Development Information Systems International, 8, 2011.
[9] WFP, mVAM: Mobile Vulnerability Analysis and Mapping Overcoming Obstacles & Scaling Success, 2016.
[10] WFP, Somalia and DR Congo: two very different guinea pigs,
http://mvam.org/2015/03/02/somalia-and-dr-congo-two-very-different-guinea-pigs/, 2013.
[11] Mock, N., N. Morrow, A. Papendieck, S. Curdumi Pendley, M. Hudson, Review of mVAM programme: novel application of mobile technologies for food security monitoring, DISI – Development Information Services International, 2015.
[12] Ibid.
[13] Maxwell, D. and R. Caldwell (2008) The Coping Strategies Index: A tool for rapid measurement of household food security and the impact of food aid programs in humanitarian emergencies. Field Methods Manual. Second Edition, 2008.
[14] Weismann, D., L. Bassett, T. Benson, and J. Hoddinott, Validation of the world food programme's food consumption score and alternative indicators of household food security, IFPRI Discussion Paper, 2009.
[15] Mock, N. et al, 2015.
[16] Bauer, J.M., Mouillez, A.C and Husain, A. Not a Rolls-Royce but it gets you there: remote mobile food security monitoring during the Ebola crisis, Humanitarian Exchange, 64, 2015.
[17] WFP, Yemen, Against All Odds. http://mvam.org/2016/01/12/yemen-against-all-odds/, 2016.
[18] Mock, N. et al, 2015.
[19] WFP, Iraq Crisis Situation Report #26, 2015.
[20] UNOCHA, Humanitarian Response Plan : Iraq, 2015
[21] Mock, N. et al, 2015.
[22] ibid.
[23] Food and Agriculture Organization, West Africa: Ebola outbreak puts harvests at risk, sends food prices shooting up,
http://www.fao.org/news/story/en/item/242177/icode/, 2014.
[24] Cornish, C., Bearing Witness to the Crimes of the Islamic State, IRIN,
http://www.irinnews.org/report/101853/bearing-witness-to-the-crimes-of-the-islamic-state, 2015.
[25] FEWS NET, Yemen Food Security Outlook October 2015 to March 2016, 2015.
[26] Joint Research Center, Impact of the West African Ebola Virus Disease Outbreak on Food security, JRC Science and Policy Reports, Luxembourg, 2014.
[27] Glennerster, R. and T. Suri, The Implications of the Ebola Outbreak on Markets, Traders, and Food Security in Sierra Leone, The International Growth Centre, 2014.
[28] CILSS, Cadre Harmonisé d'identification des zones et des populations en insécurité alimentaire au Sahel et en Afrique de l'Ouest, 2015.
[29] Pasquier, J-B, Remote Surveys to monitor IDPs Leaving Displacement Sites,
http://kth.diva-portal.org/smash/record.jsf?pid=diva2%3A885086&dswid=5103; 2015.
[30] WFP, Iraq Bulletin #14, 2016.

[31] Mock, N. et al, 2015.

[32] Mock, N., N. Morrow, and A. Papendieck, From complexity to food security decision-support: Novel methods of assessment and their role in enhancing the timeliness and relevance of food and nutrition security information. Global Food Security, 2.1, 41-49, 2013.